Magnetic perturbation as a viable tool for edge flow and turbulence modifications

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The paradigm of 2D axisymmetry in magnetically fusion devices is presently insufficient to describe all the regimes observed in fusion experiments. Indeed, apart from intrinsic 3D configurations such as stellarators [1], the effects of non-axisymmetric magnetic fields are becoming a fundamental issue also for tokamaks with applied RMP [2], and Reversed Field Pinches (RFPs), with the observation of a self organized helical state [3]. Experimental observations in the RFPs [4] revealed that a magnetic perturbation, generates a three dimensional flow pattern as the result of ambipolar constraints and this mechanism is likely to act independently of the configuration [5].

Aim of this contribution is to present the most recent experimental results obtained in the edge region of the RFX-mod experiment, operated both as an RFP and as a low-current circular tokamak, with a strong emphasis on the effects of magnetic perturbations on the flow, turbulence and parallel current perturbation. We will provide measurements of flow and transport properties in the external region of the plasma devoting strong emphasis on the phase relation between these quantities and perturbed magnetic field. The information will be collected both in spontaneous and stimulated helical discharges in RFPs, and in circular ohmic tokamak, the latter configuration operated in conventional $q_{95} \geq 3$ regime with the externally applied magnetic perturbation, and in $q(a) \approx 2$ configuration safely operated by means of MHD control system. The presence of a magnetic perturbation deeply modifies perpendicular flow in both the configurations. Furthermore also the dynamics of small scale fluctuations, i.e. of blobs and filaments is strongly influenced. We will describe these modification, establishing also links to local transport properties as derived by local electromagnetic fluctuations. All the experimental observation, and the comparison of the same phenomenology in different magnetic configurations, can shed a light on the transport mechanism in presence of 3D magnetic perturbations.